5 nanometer Ta/1 nm Au/1 nm Cu/7 nm IrMn/2.5 nm CoFe/0.9 nm Ru/3 nm CoFe/3 nm Cu/2 nm CoFe/2 nm NiFe/5 nanometer Ta,

5 nanometer Ta/1 nm Au/1 nm Cu/7 nm IrMn/2.5 nm CoFe/3 nm Cu/2 nm CoFe/2 nm NiFe/5 nanometer Ta,

5 nanometer Ta/1 nm Au/1 nm Cu/7 nm IrMn/3 nm CoFe/3 nm Cu/3 nm CoFe/2 nm Cu/3 nm CoFe/7 nm IrMn/5 nanometer Ta,

5 nanometer Ta/1 nm Au/1 nm Cu/7 nm IrMn/3 nm CoFe/3 nm Cu/1 nm CoFe/2 nm NiFe/1 nm CoFe/3 nm Cu/3 nm CoFe/7 nm IrMn/5 nanometer Ta,

5 nanometer Ta/1 nm Au/1 nm Cu/7 nm IrMn/2.5 nm CoFe/0.9 nm Ru/ 3 nm CoFe/3 nm Cu/3 nm CoFe/3 nm CU/3 nm CoFe/0.9 nm Ru/2.5 nm CoFe/7 nm IrMn/5 nanometer Ta,

5 nanometer Ta/1 nm Au/1 nm Cu/7 nm IrMn/2.5 nm CoFe/0.9 nm Ru/3 nm CoFe/3 nm Cu/1 nm CoFe/2 nm NiFe/1 nm CoFe/3 nm Cu/3 nm CoFe/0.9 nm Ru/2.5 nm CoFe/7 nm IrMn/5 nanometer Ta.

In place of the underlayer of Au/Cu as in the above, other various laminate films and alloy layers such as those mentioned hereinabove are also employable herein.

Other examples are substrate/5 nanometer Ta/7 nm IrMn/2.5 nm CoFe/0.9 nm Ru/3 nm CoFe/3 nm Cu/2.5 nm CoFe/MR-improving layer/2.5 nm CoFe/3 nm Cu/3 nm CoFe/0.9 nm Ru/2.5 nm CoFe/7 nm IrMn/5 nanometer Ta. In this structure, the moiety of CoFe/MR-improving layer/CoFe is the free layer, in which the constituent films are ferromagnetically coupled to each other.

In these examples, the antiferromagnetic layer is of IrMn, which, however, is not imitative. In place of IrMn, other various antiferromagnetic materials of NiMn, PtMn, PdPtMn, RhRuMn, CrMn, NiO and the like are also usable to produce the same good results as herein.

Spin valve films in which the pinned magnetic layer is of an antiferromagnetically coupled structure of, for example, CoFe/Ru/CoFe/IrMn (in this, two CoFe layers are as laminated via Ru therebetween are antiferromagnetically coupled to each other) also produce good results of the invention. In the laminate films illustrated herein, the constituent layers each having a predetermined thickness are antiferromagnetically coupled to each other.

In the laminate films, the interlayer may be the MR-improving layer of the invention. For example, the laminate films are 2.5 nm CoFe/1 nm AuCu/2 nm CoFe/IrMn (in which the layers are antiferromagnetically coupled to each other), IrMn/2 nm CoFe/1 nm AuCu/2 nm CoFe (in which the layers are antiferromagnetically coupled to each other), etc. Apart from those, a laminate film of 1 nm CoFe/0.5 nm AuCu/2 nm CoFe/7 nm IrMn is also employable, in which the layers are ferromagnetically coupled to each other. The AuCu layer as disposed between the pinned magnetic layers is to antiferromagnetically couple the both magnetic layers to each other, while making the interface between the coupled layers

have mirror-reflectivity and stabilizing the lattice constitution in IrMn, whereby the thermal stability and the MR characteristics of the spin valve film are improved. It is desirable that the thickness of the MR-improving layer in the spin valve film of that type falls between 0.5 and 2 nanometers.

Example f:

For realizing crystal structures with good thermal stability, which have few ordinary intergranular boundaries (ordinary intergranular boundaries in spin valve films worsen thermal stability of the films) but may have some small angle tilt boundaries and which are not of completely single crystals, the MR-improving layer of a laminate film or an alloy layer of Au/Cu or the like is effective. One example of the structure is thermally-oxidized silicon substrate/5 nanometer Ta/1 nm Au/1 nm Cu/3 nm CoFe/3 nm Cu/2 nm CoFe/7 nm IrMn/5 nanometer Ta. This was analyzed through sectional TEM and diffractiometry. The spot size in diffractiometry was so defined that the spot diameter could cover all region of the laminate film to be analyzed, in its thickness direction. For more detailed analysis, the spot diameter may be more reduced as in microdiffractiometry.

The diffractiometry of the film gave a diffraction pattern indicating a single-crystal-like structure in the entire region of 1 μm or more, from which it is understood that